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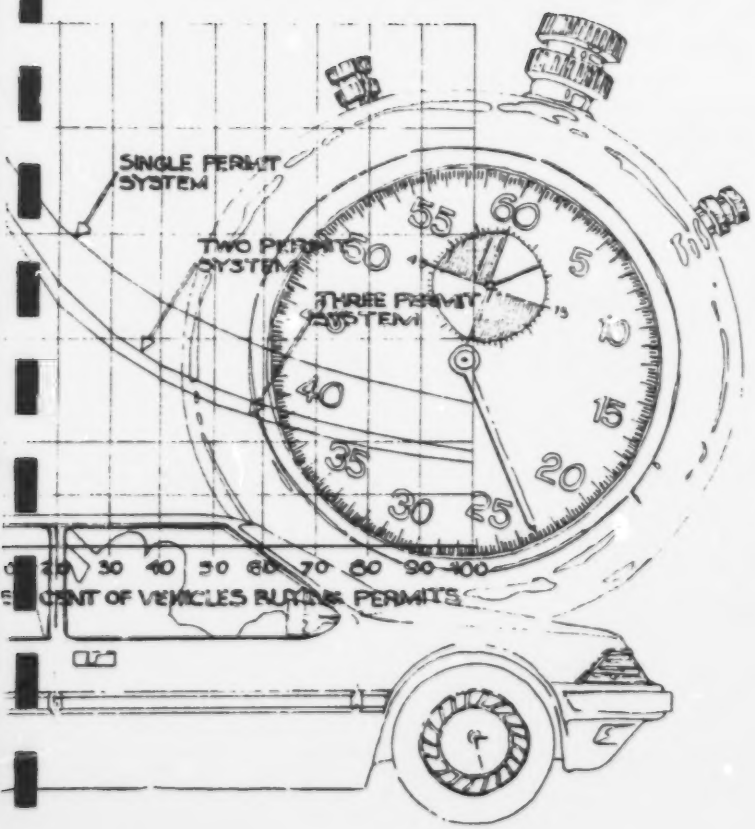
National Park Entrance Gateways

A statement on the relationships between fee collection policies and the traffic capacity requirements for entrance gateways in the Western Region of the Canadian Parks Service.



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This paper was produced from data obtained by the help and cooperation of management and staff in several parks over several years. Acknowledgement is noted with thanks.

1. INTRODUCTION

During the 1970s and 80s, policies on the sales of motor vehicle permits at national park entrance gateways underwent a variety of changes. Examples include:

- prior to the 1975 Western Economic Opportunities Conference, the normal procedure was that all vehicles entering national parks were required to display or purchase a motor vehicle permit. The typical motorist in a private vehicle was sold a permit that was valid over the course of a fiscal year. The resolutions of the Conference resulted in a policy that commercial vehicles and non-visitor through traffic were no longer required to purchase a permit.

- as cost-saving measures, some entrance gateways such as that at Yoho National Park were permanently closed and others went into reduced operations.

- in addition to the permit valid for a year, short term permits for one and four days were introduced.

- at the Banff East Gate, congestion and delay - particularly for those visitors in possession of a valid permit - was relieved by creation of an unstaffed lane which was designated for use by those vehicles in possession of a permit.

The implications of changes such as those listed above have been quite extensive. Examples include:

- there are many instances when visitors can enter a park under quite legitimate circumstances without a permit because there was no opportunity to purchase a permit at the time of entry.

- operating efficiency of the gateways declined under the multi-permit system as the options were explained and the motorists took time to consider their choices.

- opportunities to cheat were created by the honor system, enforcement is difficult and expensive and the

image of the Canadian Parks Service has been somewhat tarnished.

What had been a fairly tight, efficient and well respected fee collection system has evolved into one of decreased efficiency and a system with inconsistent applications and inconsistent effects.

A Revenue Task Force is currently examining the sources of revenue available to the Canadian Parks Service. The Terms of Reference for this program include:

- "address pressing revenue issues such as exemptions for seniors, through traffic exemptions, the price approval process, revenue sharing, expanded services for which fees should be levied;"

- "plan and develop policies related to fee setting, implementation and administration, ensuring potential impacts on tourism, levels of service to the public, cost and timing are considered;"

Updated policies and fee schedules are expected around 1990.

Concurrent to the work of the Task Force, some Park Superintendents are facing the need to create, relocate or renew gateway facilities. There are some uncertainties as to how capital or major maintenance expendituress should be planned because the work of the Task Force and the ensuing results and policies have not been finalized.

In the fall of 1988, a Task Force on Strategic Objectives produced "Charting the Course", a statement of the Mission, the Vision and the Strategic Direction for the Canadian Parks Service "over the coming years." The statement contains a variety of guidelines that can be considered relevant to the planning and operation of park entrance gateways.

From the Mission: national parks will be "attractions for national and international tourism." For most visitors, the entrance gate is the first point of contact with the national park; the point where the visit to the park begins and where first impressions are formed. Thus, the gateway has the potential to provide a pleasant welcome to the visitor which, in turn, enhances the attractiveness of the park.

From the Vision: the Canadian Parks Service will be "...an innovative, foreward-looking organization demonstrating...leadership and service to the public." The gateways should be models of efficiency and service to the public, particularly because they are a point of delay and cost to a visitor anxious to get on with enjoyment of the park.

From the Strategic Direction: "..relieve the growing burden of unnecessary processes and administrative procedures."

Finally, there are Priority Actions:

- "demonstrate the commitment to improving service"
- "solicit innovative suggestions by all staff and incorporate these into decision-making."

This paper has been prepared for two main purposes that reflect the guidelines in "Charting The Course":

- a background document for the Revenue Task Force to use in their deliberations on fee and permit policies, and

- a reference document for use in Regional gateway planning and operational issues.

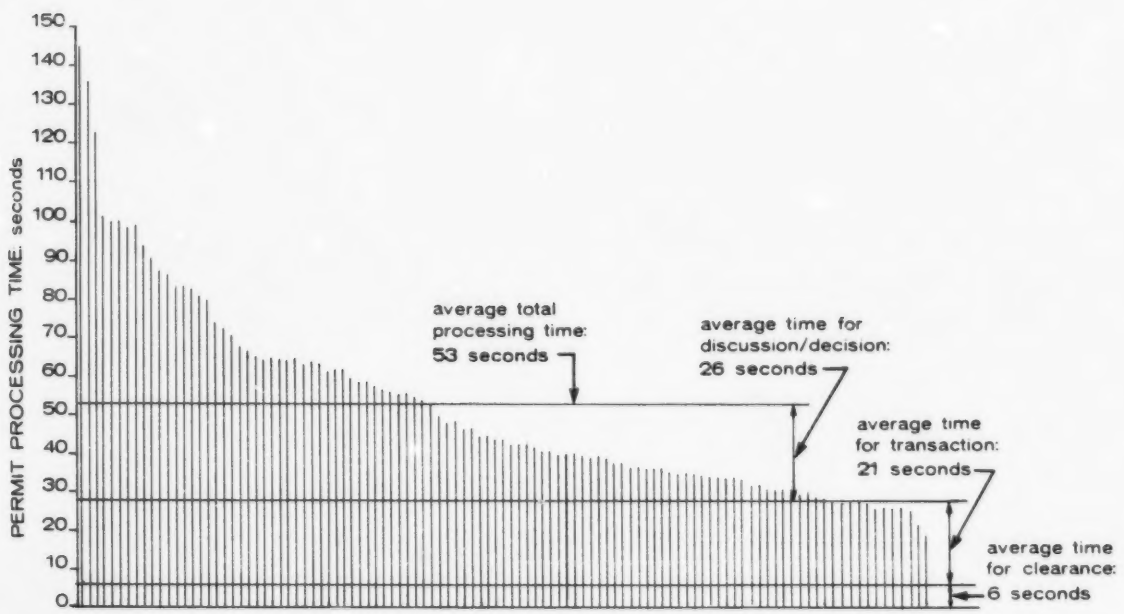
2. THE ENTRANCE GATE PROCESS

The time required to process a permit sale through an entrance gate - from when a vehicle arrives at the kiosk until the next vehicle waiting in line arrives - has three components:

- discussion/decision phase
- transaction phase
- clearance phase

Observations on approximately 100 permit sales at the Mt. Revelstoke West Gate during mid-summer 1988 provided some quantative insights into the process of buying a permit. Graphic results of the observations are illustrated in Figure 1.

Figure 1: COMPONENTS OF VEHICLE PROCESSING TIME FOR 107 PERMIT SALES
Mt. Revelstoke West Gate July, 1988



After a vehicle arrives at a kiosk, the first phase is the discussion/decision process that takes place in a dialogue between the attendant and the party in the vehicle. Permit options are explained and discussed and then a decision is made on whether to buy a permit, and if so which type to buy. This phase averaged 26 seconds at the Mt. Revelstoke gate but ranged up to two minutes as the party weighed their options.

Many people were unsure of their whereabouts beyond a day or two ahead and were reluctant to commit themselves to the four day permit. Time is also consumed during this phase as the visitors make enquiries about the location and availability of campsites, information bureaus, what constitutes a visitor or non-visitor, travel times and distances, et cetera.

The second phase is the transaction period following the decision on what type of permit to purchase. This phase averaged 21 seconds which are consumed in finding some money for the attendent and then the attendent processing the transaction and returning the permit and change to the driver. The range on the time for this phase is fairly narrow with occasional exceptions for processing travellers cheques or American currency.

The third phase is the clearance period whereby the processed vehicle leaves and then the next vehicle moves up to the kiosk. This period averaged six seconds, again in a narrow range that varied according to the length and type of vehicle and the alertness of the driver next in line.

Regardless of the type of permit system employed, phases 2 and 3 of the process of buying a permit have little potential

for improvement because they require a necessary sequence of events to transpire. However, the decision/discussion period which on the average consumes approximately one half of the total processing period, could be significantly reduced. The key is a simple permit system that leads to a quick decision on what permit, if any, is needed. As will be noted and explained later in this statement, the the average processing time under a three permit system is significantly greater than that for a one permit system.

3. GATEWAY VEHICLE CAPACITY FACTORS

The traffic handling capabilities of an entrance gate kiosk or group of kiosks can be expressed as capacity in vehicles per hour. Several factors influence this capacity.

The most significant variable in identifying the capacity of a kiosk is the portion of approaching vehicles that need to purchase a permit. Vehicles not needing a permit can be processed through a kiosk at rates in the order of 5 to 8 times faster than that of the rate for vehicles purchasing a permit.

Private motor vehicles normally constitute 90% to 95% of the traffic stream approaching an entrance gateway and are required to purchase a permit unless they are identified as:

- repeat traffic in possession of a permit,
- Canadian senior citizens,
- park-based (residents),
- through traffic, when applicable.

The portion of private vehicles required to purchase a permit at Western Region gateways can range from essentially zero in some circumstances up to 60% or 70% on some occasions.

The 5% to 10% of the traffic that is not private vehicles is primarily fee-exempt commercial or business traffic or buses which have a separate fee structure. The volume of buses in the traffic streams is not significant enough to be considered separately in gateway capacity analyses.

The second most important variable in gateway capacities is the type of permit system employed by the Canadian Parks Service. A single permit system is simple to administer and

results in a relatively high gateway efficiency and capacity. A single permit system can apply to all traffic as was the case up to the mid-1970s or for a traffic stream with a substantial number of exemptions (current practice).

A two permit system (annual and short term) adds complexity to the gateway operations as the options are explained to the visitor and the choice determined. Kiosk efficiency is less than ideal and capacity drops significantly compared to the single permit system.

The three permit system currently in use (one-day, four-day, annual) incrementally adds to the complexities and capacity constraints of the two permit system.

The third variable affecting kiosk capacity is the planned level of service to be offered to the travelling public. If a defined measure of acceptable delay is not considered in gateway capacities, a relatively low capacity facility can be provided because all vehicles can eventually be processed. But the specter of dozens or even hundreds of vehicles frequently queued up at an entrance gateway is clearly an unacceptable level of service to the public and not consistent with the intent of "Charting the Course".

In defining an acceptable amount of delay, two uncontrollable considerations must be dealt with. First is the fact that traffic streams, while described in vehicles per hour, are random in the sense that unless a road is saturated with traffic, there will be minutes in an hour where several vehicles arrive and there will be minutes when no vehicles arrive. Second is the fact that while the portion of

vehicles purchasing permits can be described for a time period (say, 50% for an hour), there will be random variations in the time frame where 5 vehicles in a row will purchase permits or 5 in a row will not need to purchase a permit.

Thus, acceptable delay can only be expressed in averages over a period of time with the recognition that some will be delayed more than the average, some less. Delay is most realistically and vividly expressed in terms of the size of the queues that form at kiosks. A good level of service to the public can be provided if the planned delay is such that for each kiosk, the average queue over the course of an hour does not exceed 5 vehicles. This practical rather than theoretical capacity means that if the average queue over an hour did average 5 vehicles, there is a 31% probabability that a queue of 10 or more vehicles will build up sometime during the hour. There is also a 9% probability that there will be no queue at some time during the hour and thus an approaching motorist will experience no delay.

4. VEHICLE PROCESSING TIMES

For purposes of analyzing gateway capacity requirements, two catagories of vehicle headways need to be considered:

1. Vehicles that do not need to purchase a permit.
2. Vehicles that need to purchase a permit.

In stating the criteria for each of the above catagories, it is appropriate to note that the intentions of the kiosk attendent and those of the motorist often differ sharply. The attendent, of course, wishes to determine if a permit is needed and then either wave the driver on or sell the appropriate permit as quickly as possible. The motorist will acknowledge the permit process but is frequently also interested in directions and distances, fishing conditions, the location and availability of campsites and so on.

The extent to which each party satisfactorily realizes their objectives is a function of the skills, knowledge and experience of the attendent in the kiosk. The analyses presented in this report are generally based on gateway studies carried out with attendents that had been on the job for quite some time and hence able to operate their kiosks quite efficiently. Attendents with less time on the job or with less skills will not realize the same efficiency. Thus the following criteria presented for kiosk requirements must be considered as minimums. Observed variations in average vehicle processing times, that are related to the skills of the attendants, can increase average processing time up to 20%.

Vehicles that do not need a permit can be processed through

gateway kiosks at rates that generally range from a minimum of about 5 seconds to a median of about 8 seconds and up to 30 seconds or more when drivers seek a lot of information. For purposes of this analysis, those vehicles not needing to purchase a permit can be processed on 8 second headways.

As noted previously, the headways for vehicles needing to purchase permits are a function of the permit system employed. For a one-permit system for all private vehicles*, the average time to process a permit sale averages in the range of 24 to 30 seconds. For purposes of this analysis, 26 seconds will be used. Gates such as Banff East could probably operate at a little less than 26 seconds. At this gate there is a large portion of the drivers who have previously purchased permits and hence are familiar with the process. Gates such as that at Waterton will operate on the high side of the design figure because of the large number of Americans arriving directly from the United States and not in possession of, nor familiar with Canadian currency.

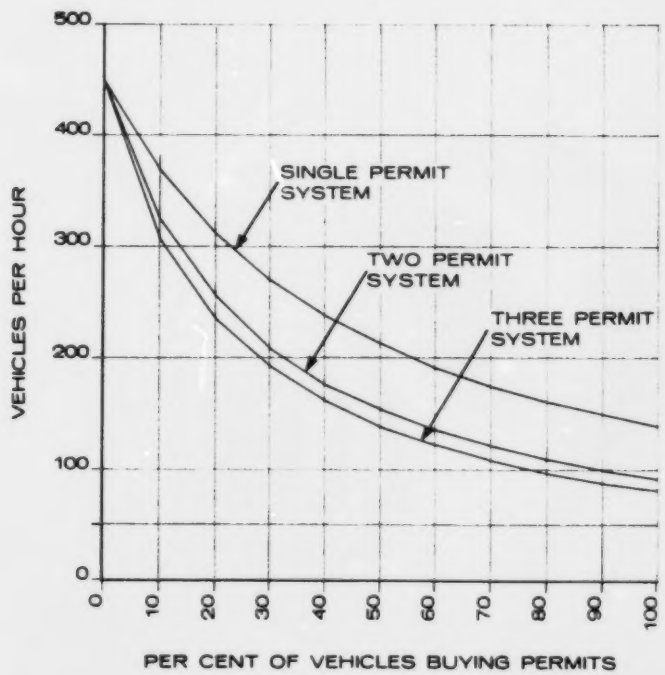
For a two-permit system, average processing time for a sale ranges from about 37 to 43 seconds. For purposes of this analysis, 39 seconds will be used recognizing that some gates can operate faster than this figure; some will be slower for reasons similar to those cited for the one-permit system.

*Data on which single permit criteria are based is from the early 1970s when all private vehicles were required to have a permit. There is no data base for a one permit system with exemptions such as for through traffic. Average processing times for such a system would presumably fall between the one and two permit systems described in this statement.

For a three-permit system, average headways for permit sales range up to about 47 seconds as visitors debate the merits of the choices and the costs of the options. For purposes of this analysis, the average processing time for a permit sale under a three-permit system will be 44 seconds.

The theoretical capacity of a single kiosk as a function of the portion of vehicles buying permits is illustrated for each type of permit system in Figure 2.

Figure 2: THEORETICAL CAPACITY OF AN ENTRANCE GATE KIOSK



As shown in Figure 2, if no vehicles were required to purchse a permit, the theoretical capacity of a kiosk is 450 vehicles

per hour, regardless of the permit system. This figure has little practical reality because if there were no permit sales, then there is no need for a kiosk to be open and staffed to check traffic.

In the more normal situation when a portion of the vehicles are buying permits, the single permit system has distinct advantages in terms of kiosk capacity. For example, when permit sales are made to 30% of the traffic, a kiosk operating under the single permit system for all private motor vehicles can handle 41% more vehicles per hour than the 3 permit system and 30% more vehicles than the two-permit system.

5. QUEUEING THEORY

The mathematics of queueing theory are appropriate for determining practical or operating requirements for kiosks at national park entrance gateways in the Western Region. The algabraic expressions, with kiosk capacity based on the portion of vehicles purchasing permits (as shown in Figure 2) are:

1. The average number of vehicles in the queue over the course of an hour is:

$$\bar{Q} = \frac{\rho(2-\rho)}{2(1-\rho)} \text{ where } \rho = \frac{\lambda}{\mu} \text{ and}$$

λ = random arrival rate in vehicles per hour

μ = kiosk capacity in vehicles per hour

2. The average delay per vehicle, expressed in minutes is:

$$\bar{d} = 60\left[\frac{2-\rho}{2\mu(1-\rho)}\right]$$

3. The probability of a queue of greater than n vehicles forming at a kiosk over the course of an hour is:

$$Pq>n = 1 - \sum_{n=0}^{n} (1-\rho)\rho^n$$

6. GATEWAY KIOSK REQUIREMENTS

For planning purposes, the number of kiosks required at an entrance gateway is a function of the type of permit system employed and the arrival volumes of traffic that need to be processed through the gateway and includes a planned level of service.

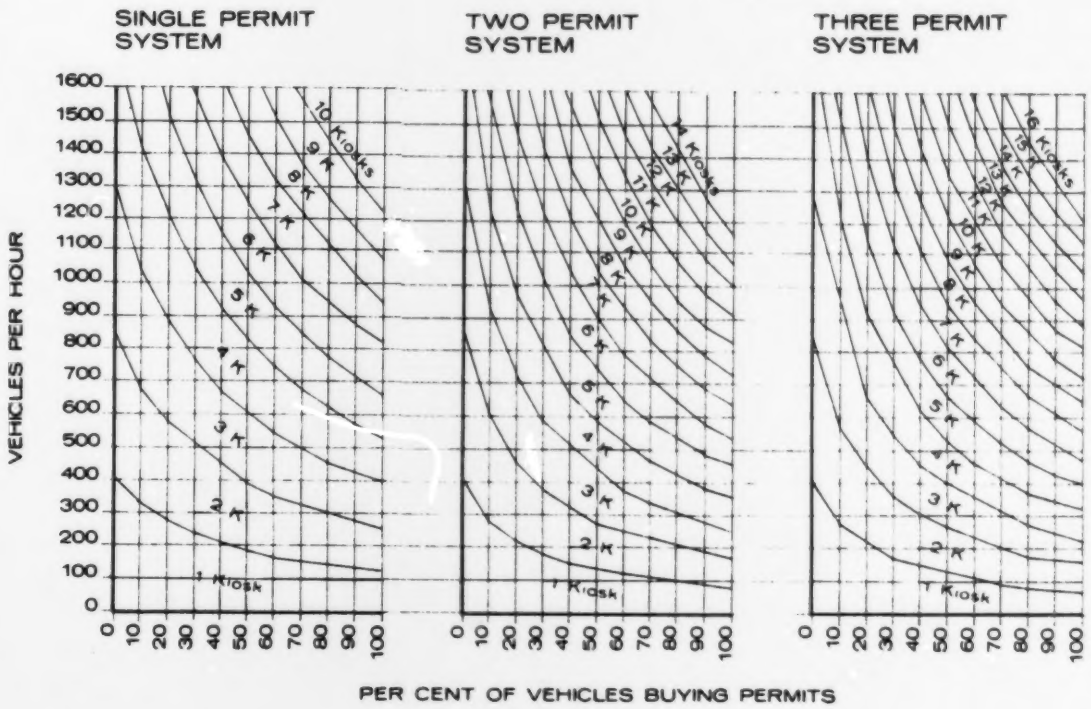
With one exception, all gateways in the Western Region are currently located on 2-lane highways. The absolute maximum approach volumes that will be experienced on 2-lane highways is about 700 vehicles per hour. This represents a high level of congestion as experienced occasionally at the West Gate on the Trans Canada Highway in Mt. Revelstoke National Park. A more appropriate maximum approach volume for design purposes on 2-lane highways would be in the order of 500 to 600 vehicles per hour.

The only entrance gate in the Western Region that is located on a high capacity highway is that on the Trans Canada at the east Boundary of Banff National Park. This gate is on a 4-lane rural freeway, but for about 2 kilometers eastward from the gate, the highway has 3 westbound lanes. Current maximum hourly approach volumes are approximately 1300 vehicles although the highway could comfortably feed 2000 per hour to the gate.

Figure 3 following, depicts by type of permit system, kiosk requirements as a function of the approach volumes and the portion of vehicles buying permits. Requirements to process 1600 vehicles per hour are shown for each case although the practical limits for gates on 2-lane highways are about a

third of 1600. For all cases, the kiosk requirements are based on average queues per kiosk not exceeding 5 over the course of an hour.

Figure 3: KIOSK REQUIREMENTS



A digest of the information in Figure 3 is presented following as kiosk requirements for various operating conditions. The digest vividly illustrates variations in gateway operating requirements associated with the various permits systems. The single permit system will typically require one less kiosk than the two permit system and in some cases, two less kiosks less than the three permit system.

Requirements on 2-Lane Highways

Operating Conditions	Single Permit System	Two Permit System	Three Permit System
20% Sales			
100 vph	1	1	1
300 vph	2	2	2
500 vph	2	3	3
700 vph	3	3	4
35% Sales			
100 vph	1	1	1
300 vph	2	2	2
500 vph	3	3	3
700 vph	3	4	5
50% Sales			
100 vph	1	1	1
300 vph	2	3	3
500 vph	3	4	4
700 vph	4	5	6

Requirements on 4-Lane Highways

Operating Conditions	Single Permit System	Two Permit System	Three Permit System
20% Sales			
1000 vph	4	5	5
1250 vph	5	5	6
1500 vph	5	6	7
35% Sales			
1000 vph	5	6	6
1250 vph	6	7	8
1500 vph	7	8	9
50% Sales			
1000 vph	5	7	8
1250 vph	6	9	10
1500 vph	8	10	11

7. CONCLUSIONS

From the perspective of the visitor, it is clear that the more simple the permit system, the quicker he can get through the gate. The sense of frustration experienced with delay will be minimized and the first point of contact with the national park will be presented as an efficient operation designed to speed him onto his visit in the park.

From the perspective of the Canadian Parks Service, the more simple the permit system the less the requirements for staff and for capital and maintenance expenses.